Age Related Evolution of Sexual Dimorphism in the Red-Necked Nightjar *Caprimulgus ruficollis*

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FORERO M. G., J. L. TELLA & L. GARCIA (1995): Age related evolution of sexual dimorphism in the Red-necked Nightjar (*Caprimulgus ruficollis*). J. Orn. 136: 447–451. — Some morphological and sexual characters were measured in juvenile, first-year and adult Red-necked Nightjars in SW Spain. We found significant age-related growth in wing, tail and body mass, first-year birds being heavier than adults. Adults showed sex differences in tail and wing lengths, and the size of tail and wing spots differed between males and females of all age classes. There was not any difference in the number of wing spots, and juvenile males had a lower number of tail spots than older males. An age-related increase in sexual dimorphism was found to exist by size increase of wing spots in males. Since wing and tail spots are exhibited in courtship displays, the elongation of these secondary sexual characters could be related to mate choice mechanisms.

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Introduction

The study and determination of sexual dimorphism is emphasized both as a research tool for further behavioural and ecological studies (GREEN 1982, BORTOLOTTI 1984, FERRER & DE LE COURT 1992, TELLA & TORRE 1993) and the understanding of the different mechanisms of mate choice and sexual selection in birds (CHARDINE & MORRIS 1989, MARTI 1990, MOLLER 1994, PLUMPTON & LUTZ 1994).

The Red-Necked Nightjar (*Caprimulgus ruficollis*) is a Mediterranean species restricted to the dry warm regions of the Iberian Peninsula and NW Africa, most of its biological aspects being unknown (CRAMP 1985, GARGALLO 1994). This nightjar does not show any apparent sexual size dimorphism. Plumage is cryptic in both sexes and the only difference between them is the size of white spots on remiges and primary feathers (SOARES 1973, CRAMP 1985, GARGALLO 1994). This information was obtained from very few samples, mainly from museum collections. Our aims are (a) to re-examine the sexual dimorphism in size and plumage, and (b) to study the possible age-related evolution of sexual dimorphism on the basis of a large sample from a Spanish free-ranging population of this species.

Methods

The study was carried out in the surroundings of Doñana National Park (SW Spain) from June to October in the 1989–94 period. A total of 952 birds were caught and ringed in the course of systematic nocturnal car transects along gravel roads, using a torch and a hand net for this purpose (JACKSON 1984). For this study we only used data from recaptured birds (n = 306) for

reliable age determination. Moreover, we added 40 skins of birds collected in the area (collection of Estación Biológica de Doñana and our own material). The later were dated regarding moult sequences (GARGALLO 1994). We grouped the birds into three age- classes: juvenile (J), first-year (one year old birds, FY), and adult (all birds after first-year, AFY). The sex was determined according to the size of the pale spots on wing and tail (CRAMP 1985, GARGALLO 1994).

The body measurements taken were: flat wing and tail length in mm, tarsus and bill length up to the point it joins the skull using a caliper (±0.1 mm); mass in grams. In 1994, we measured the white or pale spots of the three external primaries (P10, P9, P8) and of the two external rectrices (T5, T4) to the nearest mm, taking the maximum parallel length to the raquis. Feathers were dated into the same age-classes (J, FY, AFY) following moult patterns (GARGALLO 1994). First-year birds retained juvenile external primaries, so we found only two age-classes (J and AFY) of wing spots. We counted the number of spotted feathers because some birds showed an unusual number of rectrices and tail spots.

Statistical analysis comprises parametric (Student-t test, ANOVA) and non-parametric tests (Kruskall-Wallis ANOVA, Mann-Whitney U-test; ZAR 1984).

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Results

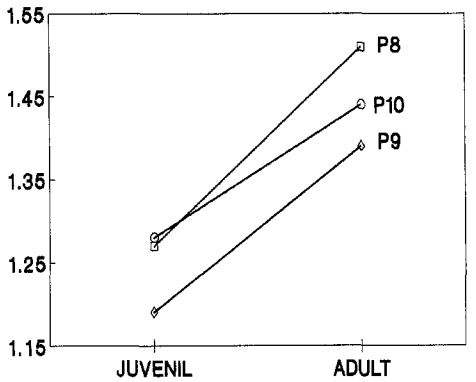
Both males and females (Table 1) showed age-related growth in tail and mass between juvenile and older birds (FY and AFY; ANOVA with multiple range tests, $p < 0.05$). Only body mass of males denoted differences between the three age-classes; first-year birds were the heaviest. The wing of adult males was longer than in first-year males. Sexual size dimorphism (Table 1) was found only in wing and tail lengths of adult birds.

Tab. 1. Body measurements of *Caprimulgus ruficollis*. Age differences were tested by ANOVA analysis, sex differences by Student-t-test.

Parameter	Age	Males		Females		Sex-diff.
		Mean (sd, n)	Age-diff.	Mean (sd, n)	Age-diff.	
WING	J	209.05 (3.42, 54)	P = 0.01	208.34 (4.16, 41)	N. S.	N. S.
	FY	206.96 (4.73, 23)		209.55 (2.71, 10)		N. S.
	AFY	210.70 (6.04, 41)		208.69 (3.69, 77)		P <0.05
TAIL	J	151.04 (7.33, 22)	P <0.001	149.77 (6.38, 22)	P = 0.001	N. S.
	FY	161.00 (4.18, 21)		156.20 (5.01, 10)		P <0.01
	AFY	158.26 (6.42, 27)		153.84 (4.45, 59)		P<0.001
TARSUS	J	22.05 (1.44, 10)	N. S.	22.41 (0.95, 18)	N. S.	N. S.
	FY	22.64 (0.82, 22)		23.76 (3.40, 10)		N. S.
	AFY	21.69 (4.39, 24)		22.22 (1.35, 18)		N. S.
BILL	J	28.30 (3.91, 10)	N. S.	28.94 (2.47, 18)	N. S.	N. S.
	FY	29.58 (1.27, 22)		28.84 (3.71, 10)		N. S.
	AFY	29.18 (1.79, 24)		28.64 (2.28, 16)		N. S.
MASS	J	92.05 (10.09, 73)	P <0.001	94.86 (10.67, 52)	P = 0.002	N. S.
	FY	111.00 (20.99, 23)		105.45 (8.37, 11)		N. S.
	AFY	102.32 (10.54, 42)		102.32 (14.75, 83)		N. S.

Sex differences were remarkable in all primary and rectrix spot sizes (Table 2). Only the wing spots of males were significantly enlarged with age, increasing the age-related sexual dimorphism (Fig.).

The number of wing spots did not differ between sexes and age-classes. However, juvenile males had less tail spots than older birds of the same sex, and first-year males more spots than first-year females (Table 2).



Increase of sexual dimorphism in the size of wing spots of the primaries P8, P9 and P10. Dimorphism is expresed as the rate between means of male an female measurements.

Discussion

Age-related body size changes and sexual size dimorphism have not been previously reported in the Red-Necked Nightjar (CRAMP 1985). It was probably due to the small size analized samples. However, our results showed growth in tail and body mass from juvenile to older birds. First-year birds were also heavier than adults. As it is frequent in species with delayed plumage maturation (NEWTON 1989), probably the majority of first year birds do not get to breed and would not be exposed to a mass loss related to reproductive effort (DONAZAR et al. 1992, MARTINS & WRIGHT 1993).

First-year males had shorter wings than older males. This fact can be due to the moult pattern of this species (GARGALLO 1994). Even at the end of the breeding season, first year birds have not moulted the external juvenile primaries, so the small differences found in wing length could be caused by worn out feathers (FRANCIS & WOOD 1989).

Sexual dimorphism in the size of the tail spots is well known in the Red-Necked Nightjar and other Caprimulgidae species (SOARES 1973, INGELS & RIBOT 1982, CRAMP 1985). INGELS & RIBOT (1982) already suggested that the variation in amount of white spots in tail and wings in the Blackish Nightjar *Caprimulgus nigrescens* could be an age-related phenomenon. We found age-related changes in the size of wing spots of males and thus an increase of sexual dimorphism in this character. This dimorphism in Red-necked Nightjar makes male the more conspicous sex. Due to the fact that males of Nightjar species brood for short spells at night and females do so during daylight (PHILLIPS 1979, JACKSON 1984, CRAMP 1985), mimicry of females has been in-

Tab. 2. Size and number of wing (P) and tail (T) spots of *Caprimulgus ruficollis*. Age and sex differences were tested by ANOVA and Student-t test respectively foe size, and by Kruskall-Wallis and Mann-Whitney test for number of spots.

Parameter	Age	Males Mean (sd, n)	Age-diff.	Females Mean (sd, n)	Age-diff.	Sex-diff.
P_{10} SPOT	J	17.74 (3.09, 27)	P <	13.77 (3.52, 22)	N. S.	P <0.001
	AFY	20.38 (2.54, 21)		14.12 (1.86, 17)		P <0.001
P_9 SPOT	J	18.96 (3.53, 26)	P <0.001	15.85 (2.68, 23)	N. S.	P <0.001
	AFY	22.79 (3.30, 22)		16.28 (2.16, 18)		P <0.01
P_8 SPOT	J	19.23 (6.15, 22)	P = 0.05	15.13 (2.65, 23)	N. S.	P <0.01
	AFY	22.33 (4.28, 23)		14.72 (3.07, 18)		P <0.01
P SPOT	J	3.00 (0 , 9)	N. S.	3.07 (0.26, 15)	N. S.	N. S.
NUMBER	FY	3.29 (0.59, 17)		3.00 (0 , 8)		N. S.
	AFY	3.14 (0.35, 22)		3.00 (0 , 16)		N. S.
T_5 SPOT	J	28.27 (3.79, 9)	N. S.	10.01 (8.33, 20)	N. S.	P <0.001
	FY	28.28 (6.99, 7)		17.50 (2.12, 2)		P = 0.08
	AFY	31.04 (4.50, 37)		13.64 (3.67, 22)		P <0.001
T_4 SPOT	J	24.00 (3.94, 17)	N. S.	7.61 (5.80, 18)	N. S.	P <0.001
	FY	24.67 (0.58, 3)		10.67 (3.21, 3)		P <0.01
	AFY	26.01 (5.96, 27)		10.28 (4.28, 18)		P <0.001
T SPOT	J	2.00 (0 , 9)	P <0.05	2.00 (0 , 14)	N. S.	N. S.
NUMBER	FY	2.35 (0.49, 20)		02.00 (0 , 9)		P <0.05
	AFY	02.10 (0.39, 19)		01.94 (0.24, 17)		N. S.

terpreted as having an adaptive value (JACKSON 1985). However, we think that this sexual dimorphism could be maintained by sexual selection related to the proccess of mate choice. Secondary sexual characters such as tail length and tail patch sizes are selected by females in several bird species (ANDERSON 1982, HÖGLUND et al. 1990, MØLLER 1994). Although these processes are not well known in the Red-Necked Nightjar, this and other phylogenetically close species perform territorial and flight displays where wing- and tail-spots are prominently exhibited (CRAMP 1985, MENGEL 1972). From this point of view, having long tails and wings with large spots can be advantageous in mating encounters.

Zusammenfassung

Einige morphologische Merkmale juveniler, einjähriger und adulter Rothals-Ziegenmelker (*Caprimulgus ruficollis*) in SW Spanien wurden gemessen. Es ergaben sich signifikante altersbedingte Unterschiede in Flügel- und Schwanzlänge sowie in der Körpermasse; einjährige Vögel waren schwerer als erwachsene. Adulte Vögel wiesen geschlechtsabhängige Unterschiede in der Flügel- und Schwanzlänge auf; die Größe der Schwanz- und Flügelflecken unterschieden sich zwischen Männchen und Weibchen aller Altersklassen. Es gab keine Unterschiede in der Anzahl der Flügelflecken; juvenile Männchen hatten aber weniger Schwanzflecken als ältere. Eine durch das Wachstum der Flügelflecken der Männchen bedingte Zunahme des Sexualdimorphismus wurde gefunden. Da die Flügel und Schwanzflecken bei der Balz eine Rolle spielen, könnte die Vergrößerung dieser sekundären Geschlechtsmerkmale mit Paarwahlmechanismen zusammenhängen.

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